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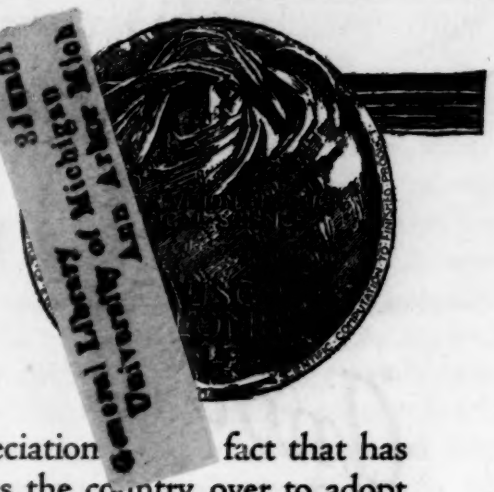

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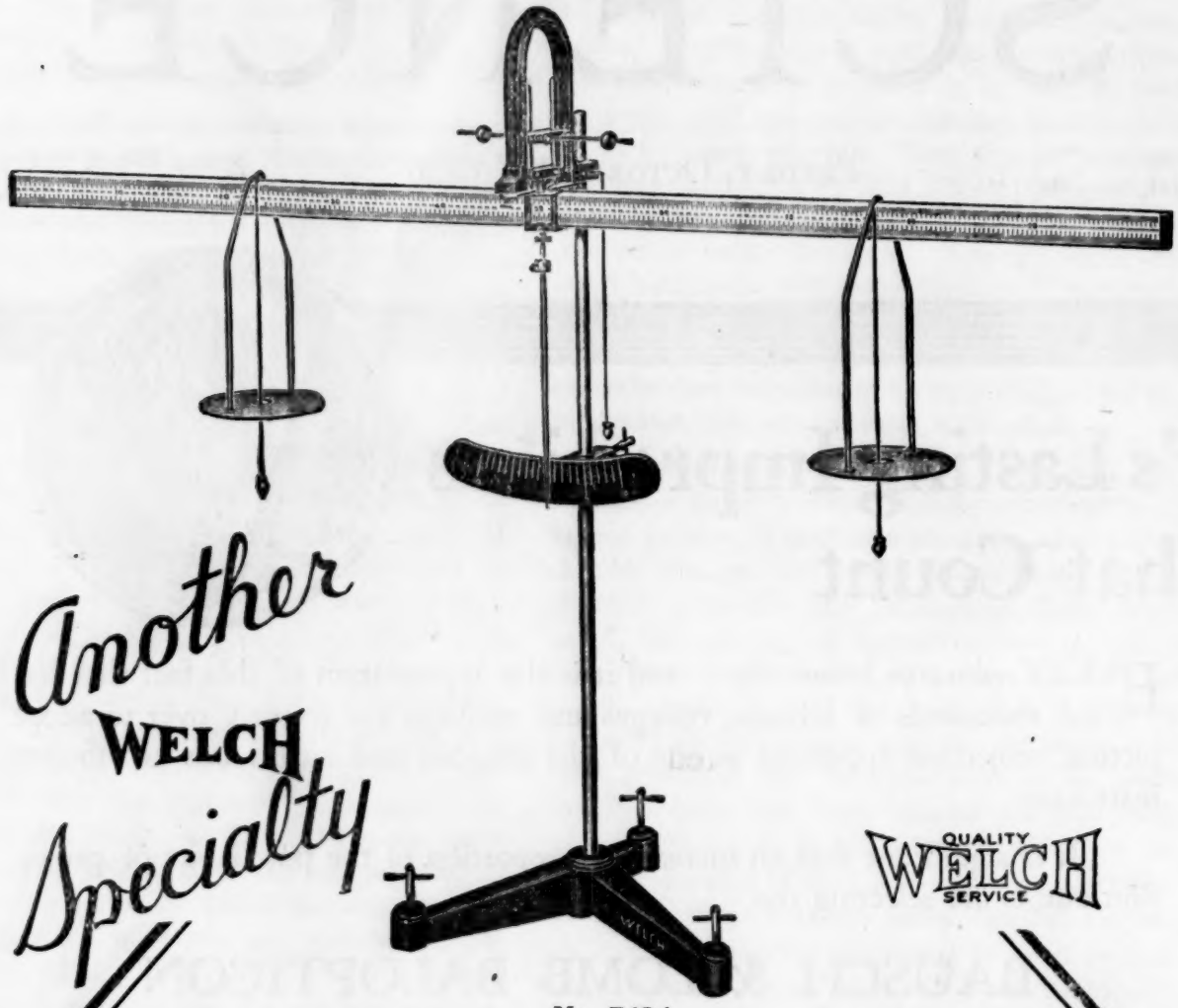

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SCIENCE

FRIDAY, OCTOBER 15, 1920

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THE SCIENTIFIC TEACHING OF SCIENCE

SCIENCE, with its introduction of the laboratory, was expected to revolutionize teaching. But the ever-recurring distrust of the new has given us a curious combination in our scientific departments of the modern laboratory, the medieval lecture, and a degenerate form of the Socratic quiz. And the student feels them about as far apart in content as in origin. While the head of the department is lecturing to him on chlorine, the second man in the department is directing him in the manufacture of sulfur dioxide, and some assistant, once a week, is extracting from his brain all it contains of hydrogen sulfide. An unsavory mess it is!

If we could accept as the purpose of education the development—perhaps it is more accurate to say the restoration—of the right mental attitude in the student, we could bring order out of this chaos. For we should then see that the dogmatic handing on of facts through lecture and text-book inculcates the wrong attitude of mind in the student. A student will much more rapidly develop the right mental attitude by discovering facts for himself, even though they were known before, than by memorizing a multitude of facts discovered by other people. Men prate a good deal these days about the conservation and development of our natural resources, and are curiously neglectful of our greatest resource, humanity's power of creative thinking. The little child is, of course, the scientist, par excellence, curious, experimental, creative. Our education must retain and build on the curiosity and experimental eagerness of the child, and develop his power of creative thought. We can never know what the new generation has to contribute to us till we give it greater opportunity to express itself. We think when we have let a student choose his

major subject we have given him all the freedom it is safe to give him.

It is curious how far we are from the idea that a university exists primarily to develop this power of creative thought in its students. If our teaching is to develop this power, we much change the focus of our work. Heretofore we have had vaguely in mind as our focus a text-book or an instructor. But instead of a tyrannical text-book or the instructor's somewhat egotistical presentation of ideas in his lectures, instead even of his charming and stimulating personality, we must chose as the focus for our teaching the student and his problems. Every student has all sorts of problems more or less consciously in mind when he comes to a university. The laboratories books and instructors should exist as aids in the solution of those. Before he has gone far in his investigations, if laboratory, library and instructor are adequate, they will have led him out toward several other departments of the university, and a continuously increasing number of other problems will be tempting him on.

The lecture, the quiz, the laboratory manual, the text-book must be tools for the student rather than guides. The logical order underlying the text-book and lecture is that of a person with many years experience in a subject. The student approaches the subject in quite a different way, touching it at only a few, possibly unrelated, points. The logic of another, more experienced mind lacks significance for him. He needs to evolve his own orderly arrangement of the subject. That is all he can, as yet, comprehend. The laboratory manual, with its arbitrarily selected experiments, is similarly objectionable; it starts not with the student's problems, but with imposed problems. No lecture, or text-book, or laboratory manual exactly fits any one's needs. The quiz as at present conducted, instead of being used even as Socrates used it to lead up to some definite idea, or instead of its being, as it ought to be, a frank give and take between coworkers, has become merely insulting.

In place of these must be substituted the laboratory, reference books, private consultation with the instructor, group discussions, and an occasional supplementary lecture. This means merely that the university exists for the student, be he called student or instructor, twenty years old or seventy, modest scientist or titled grandee. It means that the older student is to see that the younger student has what he needs to work with, that he can find the reference books he needs, that he has access to the more complete experince of this elder whenever his problem seems to require experience greater than he has at his own command. It means that instead of memorizing facts for possible future use, the student is already at his life business of solving problems, the business he began, by the way, in the cradle. The group discussion will, of course, be based on the problems that have arisen in the laboratory, will be reports of laboratory work, and will relate the knowledge gained there with other sciences or other aspects of the same science. And now and then, there may be a lecture by a visiting scientist on his specialty. There is, of course, gain rather than loss in the instructor's reporting from time to time his own research work, or some particular interest, or bibliographic suggestions, just as the other students do. Such reports will give the younger students greater acquaintance with the instructor's point of view than they could get, perhaps, merely through conversations. But in such reports the instructor takes his place as a fellow student, not as a superior. Laboratory, reference books, a more experienced scientist to consult, occasional exchange of ideas with groups of fellow workers, these are all our incipient scientists need.

For three years the experiment was made in a scientific department of one of our middle western universities of teaching by the method just suggested, so far as that could be done under the conditions that exist in every university at present. All the courses in the department were so conducted, the students ranging in rank from freshmen to graduates, and numbering usually about twenty to the course.

At the beginning of each course there were

conferences with the students, who had registered for the work, to find out why they were there, what contact they had already had with problems in this subject, what points they expected the course to clear up for them. They were asked to prepare a rough outline of the subject, limited though their knowledge was, and from this outline their laboratory work was begun, so that they began with the points of contact previously made with the subject, and were already at work organizing what slight knowledge they had.

Each student's laboratory work was made at all times the center of his activity; it was starting point and unifying element. The questions that arose in the student's mind during his laboratory work were the basis of laboratory conversations and class-room discussions. Most of the conferences on work took place in the laboratory, when problems arose. The class room was used in part for the discussion of problems that could not well be worked out in the laboratory because of lack of time or equipment. This discussion of more general problems and of investigations carried on by other scientists, though usually introduced by the instructor, was brought in when suggested by the laboratory work of the students. Each student presented, also, during this class hour, the results of his own research studies. And though many problems were individual in origin, some of them were, of course, related, and lent themselves well to group discussion. It is true the students were less interested in the discussion of each other's investigations than in their own; still, a problem that a fellow student feels vividly is more interesting than one imposed by an instructor. Nearly all work was done independently of both his fellows and the instructor, in so far as the student was able, unaided, to solve his own difficulties.

Most of the systemization of work was done in laboratory conversations between instructor and student. Such correlation was urged throughout the course. Attempt was made to order data as they accumulated. At the end of the course, this systemization was rounded out in a second outline of the subject the students prepared.

The students almost invariably floundered at first. They had grown so dependent on directions that for a time they could only with difficulty initiate work of their own. Gradually they came to understand what was expected and they became clearer as to what they themselves wanted. And as the course continued the method seemed to them increasingly desirable and successful.

There were difficulties and hindrances in applying the method, of course. Almost all of them came from having to fit it into the regular university system. It couldn't be adopted wholeheartedly because of the regular schedule; and when work was prescribed in all other courses and enforced by examinations, there was a tendency, naturally, to slight a more flexible course.

And it is difficult to persuade a student one is really interested in his opinions when all through his home and school life independent thinking has been discouraged as inconvenient. But probably it is better to save him at the eleventh hour than let his power to think be dammed forever. It certainly seems absurd to dictate all details of work to the undergraduate and expect the graduate student suddenly to manifest originality, initiative and creative power. The method of the little child and the graduate student should not be interrupted by the years of directed mental effort our present school system imposes, should not because it is inefficient, and so fatiguing as to be almost disastrous. It is equally important that the beginnings of a science be taught by the scientific method as that graduate work be so carried on. For the early years in any science should be given largely to discovery and original research, as are the early years of childhood. Thinking and first-hand contact would better come early, else they may never come.

The difficulty of handling many students in this way is more fancied than real. One can not, of course, believe it possible to know and develop individually as many students as one

can lecture at. But if lecturer, laboratory assistants, quiz aides combined and divided the entire group in any department, students would develop more power than under the present method. They might not come in contact with as many facts, but they would retain more of those they did become acquainted with, and their power of thought would be much greater. We have probably swung to an extreme anyway in paying large salaries to a few lecturing departmental heads; we should have a better faculty and consequently a more creative generation of scientists developing if we spread our resources more equably over the entire teaching force.

A few other objections to the method one always expects to encounter in any discussion of it: that students are purposeless and lazy; they must have their work planned for them and be held or driven to it. They are children. Yet an unspoiled child is purposeful. And even if a freshman is somewhat dulled by his previous training, that seems scarcely a good reason for going on with the dulling process.

One hears, too, that the years of preparation are so short and the facts of knowledge so many it is the business of the instructor to organize material into simple form, easy to memorize, and give it to the students in lectures or text-books. Of course if a university chooses to do this inferior sort of work, training accurate automata instead of turning out thinkers, that is, presumably, its privilege. One wishes, though, there were some place students who didn't choose to become automata could go. So little of life is lived at the conscious level, and it is primarily from that part of life that progress is obtained, it seems a pity to shorten a man's real living and limit his contribution by discouraging living at that higher level.

Another objection that is subconscious rather than expresed is that the method requires rather more self restraint and mental flexibility than most instructors feel equal to.

Whether or not it seems worth while to excavate beneath the crust of indifferenece formd in self-defense during the preparatory years of prescribed work will depend on the value one places on creative thinking. Perhaps it does not seem to every one our greatest natural resource; but such an one is probably not himself very creative.

It is frequently contended that under such a method of teaching a student will lack system and an orderly grasp on the whole subject. The amount of systemization of knowledge will undoubtedly vary among free students; some orderly arrangement of material there must be. But the creative mind is less intent on classifying data than in gathering more, and in projecting new theories. It cares less to make of itself a card index of the literature on any subject than to "push forward the boundaries of knowledge."

The real rock on which the method is likely to founder, however, is the executive mania for definite classification of mentality. We must rule out variations from the medium. We must know in just what stage of development each student's mind is—or rather, at just what point in the assignment of the year's work he is. However could we give degrees? We can not be bothered with all this individualized education. We don't want thinkers anyway; we want followers.

None of these difficulties and hindrances greatly matter, once we are convinced of the need for developing creative thinkers in our scientific courses.

But it will require grace to step down from the lime light of the lecture platform, to cure ourselves of this contagion of text-book writing. We elders are so sure that out of our greater experience we can save our students effort and time. It is a clogging efficiency we seek. The greatest contribution we can make to a developing mind is to "stand out of its sunlight." And in the long run, that is the most efficient method; for individual initiative produces most in the least time, and produces it with a minimum of effort and friction. The problem we ourselves find is a fascination; the problem some one else sets us is a task. And our memory in the latter case is treacherously unreliable, while the knowledge

we worry out for ourselves is seldom forgotten.

C. G. MACARTHUR
STANFORD UNIVERSITY

LEVULOSE SIRUP

THE present—and, we are told, very likely the permanent—shortage of crystallized sugar is stimulating very markedly the interest in other sugars. The consumption of glucose or corn sirup is increasing steadily; the making of sorghum sirup bids fair to return to the prominent place it once held; our friends the bees are being exploited more and more; and a great many breweries, instead of retiring as requested, are now malting grain as usual, but instead of fermenting it are converting it into maltose sirup. Of the above four sugar products, sorghum and honey are the only ones which compete with cane sugar in sweetness; maltose is much less sweet, and glucose is very much less sweet, than sucrose. Now, it is sweetness that we demand; we do not eat sugars and sirups primarily for their calories, but because they sweeten other, less palatable, and cheaper, food products. Therefore, glucose and maltose have very natural limitations on their extensive utilization, if sweeter materials can be found. Of the two sweeter products, honey will probably of necessity always remain a luxury; and sorghum sirup has a flavor that precludes its unlimited use for all purposes, although it should be said that this flavor can be almost entirely removed, with practically only the sweetness remaining, and that there is a possibility of an enormously increased utilization of sorghum in this way. Is there not, however, a sugar which is sweeter than any of the above, which is not now of commercial importance, but which possibly could be obtained in large enough quantities and at a low enough cost to become important?

Levulose, fructose, or fruit sugar, is the sweetest known sugar. Exact data as to the relative sweetness of the various sugars are not available, but it is often stated that levulose is 30 to 50 per cent. sweeter than sucrose. A levulose sirup, then, would be a distinct asset in the present commerce in sweet products. Levulose occurs in practically all fruits, is abundant in honey, and is found in appreciable amounts in sorghum sirup. Its most conspicuous occurrence in plants, however, is in the form of inulin in the tubers of the Jerusalem artichoke and in the bulbs of the dahlia. Inulin is a polysaccharide somewhat resembling starch, but whereas starch yields glucose on hydrolysis with acid, as in the manufacture of corn sirup, inulin yields levulose.

The inulin is present to the extent of 12 to 14 per cent. of the fresh tuber. As is well known, the artichoke gives very large yields, from 700 to 1,000 bushels per acre being normal. If one assume 40,000 pounds per acre, and a 10 per cent. recovery of inulin from the tubers, there would thus be 4,000 pounds of sugar per acre. A 50-bushel crop of corn yields about 2,000 pounds of starch; an acre of good sorghum yields about 1,600 pounds of sugar; an acre of sugar beets, 3,000 pounds; an acre of sugar cane 3,000 to 4,500 pounds.

Thus it is seen that the possible yield of sugar from artichokes compares very favorably with that of our other sugar crops; and the writer believes, on the basis of the above facts, that levulose sirup from artichoke tubers is one of the most promising sugar possibilities that we have. The levulose would probably have to be in sirup form, since it crystallizes with difficulty. The above figures are estimates based on known yields and analyses of artichokes. The unknown factor in the proposition at present is the technology of manufacture. Practically nothing is known about the isolation of the inulin and its hydrolysis to levulose on a commercial scale. But what is known concerning the chemistry of these substances gives us every reason to believe that the problem connected with the manufacture of levulose sirup could be solved, as were those in the manufacture of the other sugar products. Likewise the question of the cost of production is unknown. Since, however, the resultant product would be so much sweeter than any of the present sugars, it would be worth considerably more, and a greater cost of manufacture, if such should

be the case, would not necessarily be a handicap.

The usefulness of a levulose sirup is apparent. It would probably not be used alone as a sirup, but would be used for blending with other sirups to enhance their sweetness. Glucose and maltose sirups would be greatly improved if their sweetness were increased. And in the manufacture of soft drinks and confections levulose could very largely replace sucrose, and thus increase the amount of the latter that would be available as dry sugar.

In view of the above considerations, therefore, it is to be hoped that some institution, federal, state, or industrial, will see fit to inaugurate investigations on the production of levulose sirup from the Jerusalem artichoke, in order to augment our present sources of sweetness.

J. J. Willaman

University of Minnesota

RESOLUTIONS OF THE PAN-PACIFIC SCIENTIFIC CONFERENCE

V. GEOLOGY

1. *Geological Maps*

In the interest of science be it

Resolved, That the following maps of the Pacific region on the international scale of 1:1,000,000 be prepared as expeditiously as possible:

(*a*) A base map showing by contours or hachures as many topographic features as practicable.

(*b*) A map showing geological formations or groups of geological formations.

(*c*) A map showing mineral resources.

2. *Geological Surveys of Critical Insular Areas in the Pacific Ocean*

(*a*) Geological Survey of Easter Island

Since a knowledge of the geology of Easter Island might throw light on the question of whether there was in past geological time a westward extension of the land area of South American continent, be it

Resolved, That it is desirable to have a careful study of Easter Island to determine the character and geologic age of the rocks composing that island.

(*b*) Geological Survey of the Hawaiian Islands

Since the results of a detailed geological survey of the Hawaiian Islands would aid in the solution of many problems of the Pacific region, be it

Resolved, That this conference strongly recommends that a geological survey of the Hawaiian Islands be made and that appropriate geological maps and descriptive texts be published.

(*c*) Geological Survey of the Several Small Islands in Eastern Fiji

Since raised coral atolls with exposed basements of bedded limestone or of volcanic material are found in eastern Fiji, and since a geological survey of these islands supplemented by reconnaissance work in the neighborhood of Suva would be invaluable in the study of the origin of coral reefs, and in elucidation of the geology of the southwest Pacific, be it

Resolved, That a topographic and geological survey of the several small islands, such as Mango, Thithia, Lakemba, Vanua Mbalavu and Tuvutha be made at the earliest opportunity, and the results published.

3. *Form of Ocean Bottom*

Because of their importance as supplements to geological work on land in determining the structural framework of the Pacific region and in interpreting the geological history of the region, be it

Resolved (*a*), That the configuration of the bottom of the Pacific ocean be determined with adequate accuracy.

(*b*) That charts of the littoral and sub-littoral zones be made in all practicable detail, for example, wherever possible these charts should be on scales ranging between 1:10,000 and 1:40,000.

4. *Post-Cretaceous Correlation*

Since such knowledge is essential to the establishment of an adequate basis for the stratigraphic correlation of the post-Cretaceous formations of the Pacific region, be it

Resolved (*a*), That in addition to the study of the post-Cretaceous stratigraphy and paleontology of the Pacific islands and of the land areas on the margins of the Pacific Ocean, that such work also be expedited in the Caribbean region, and in the region from Burma through the Himalayas to the Mediterranean Sea.

(*b*) That inventories of the living fauna and flora of the Pacific region be prepared at the earliest practicable date.

5. *Studies of Subaerial and Submarine Erosion*

Since it is coming to be recognized generally that a knowledge of subaerial and submarine erosion is indispensable to a correct interpretation of the history of the continents, the continental margins, and the oceanic islands during post-Cretaceous time, be it

Resolved (*a*) That geologists, geographers, seismologists, biologists and others who are interested in the facts of form within the Pacific Ocean and along its margins devote attention to the study of physiographic processes and the forms resultant from such processes.

(*b*) That geologists and physiographers make special study of the physical, chemical and other properties of igneous and sedimentary rocks so as to ascertain the difference in their resistance to erosive agents.

(*c*) That efforts be made to obtain assistance in furthering the study of such important agents as wave and current erosion, factors limiting wave base, the action of weathering and corrosive agents at the headwaters of streams, the forms of stream channels, the form of sea cliffs at different stages of development, the action of plants in retarding land erosion, and the sequential stages of erosion of fault scarps.

6. *Studies of Sedimentary Processes and Sedimentary Rocks*

Since it is generally recognized that the interpretation of a large part of the geological record demands a knowledge of the processes and the results of these processes in the formation of deposits of past geological time; therefore be it

Resolved (*a*) That geologists, oceanographers, geographers, biologists and others who may be interested devote as much attention as possible to the study of modern sediments and the processes by which they are formed.

(*b*) That geologists make special studies of the physical, chemical and other properties of sedimentary rocks to ascertain the conditions under which the deposits were formed and the changes that may have taken place in such sedimentary rocks after deposition.

(*c*) That all existing agencies be urged to study the phenomena referred to in paragraphs (*a*) and (*b*) above, and that efforts be made to increase the number of agencies for the prosecution of such investigations.

6. *Geological Cooperation*

Since it is desirable that the projects undertaken by the different workers in the Pacific region be so selected and so designed that each may be supplementary to the rest and so contribute to the uniform accumulation of geological information concerning the Pacific region, be it

Resolved, That steps be taken to advise in the planning of research to correlate the efforts of the different workers, and to promote in such ways as may be proper a uniform mode of publication of results.

VI. SEISMOLOGY AND VOLCANOLOGY

The dominant motive which has appeared in the convention of seismologists and volcanologists of the Pacific here gathered together for the first time, has been to promote more localized and more continuous observation of regional phenomena than has hitherto been accomplished in most seismic and volcanic districts. On the other hand, there is agreement that precise teleseismic triangulation is not a field for amateurs or for stations equipped with a multiplicity of inferior and diverse instruments.

There is a crying need for mutual information, regularly supplied by each observer to his distant colleagues, concerning volcanic and seismic happenings in each land. The employment of mariners and scientific expeditions to

collect specimens and notes for the volcanologists in remote places may be organized.

Education of the people in matters of earthquake-proof construction and safeguards against disaster has been proved to be a practicable and effective method of meeting volcanic and seismic crises.

Interest has recently developed in the earth tide, changes of level about volcanoes and measurable horizontal and vertical displacements directly related to earthquakes. These are matters for the national geodetic surveys and for geophysical investigation of high mathematical precision.

The three groups of motives above enumerated, respectively, localized work, publication and education, and precise geophysics are the fundamenta on which the following seismologic and volcanologic resolutions of the conference are built.

1. *Establishment of Volcano Observatories*

Useful volcano experiment stations have already been established in some lands, and more volcanologic experience is needed for protection against disaster of the increasing populations of Pacific countries and for the advance of science; therefore this conference

Recommends the continuance of the present volcano observatories and the establishment of new permanent volcano observatories in lands about the Pacific; and recommends that such a station for maintenance and publication of continuous observations should be placed on one of the more active volcanoes in each important volcanic district.

2. *Promotion of Localized Seismometry*

In addition to the work of existing establishments, the intensive study of both large and small earthquakes in seismic provinces by all appropriate physical, geological and other scientific methods may lead to important and rapid advancement in geophysical knowledge. This knowledge is of importance for economic and humanitarian as well as scientific ends. This conference therefore

Commends the existing institutions, recommends their continuance and expansion, and urges early establishment of further specific programs of investigation and continuous observation in regional seismology, in special seismic districts about the Pacific. Timely publication of results is recommended. Moreover this conference recommends to the National Research Council of the United States the establishment of a program of research in regional seismology in the southwestern part of the United States.

3. *Publication of Volcano and Earthquake Information*

The workers in regional seismology and volcanology need accurate information about geophysical events in other localities than their own; therefore this conference

Recommends that prompt and authoritative publication of current facts and measurements concerning volcanoes, earthquakes, submarine eruptions and tidal waves be an essential part of the routine of all Pacific observatories.

4. *Precise Leveling and Triangulation in Relation to Volcanology and Seismology*

Great earthquakes and volcanic eruptions are often preceded and followed by elevations, depressions and horizontal displacements in the regions concerned; therefore this conference

Recommends that precise leveling and triangulation be carried on at definite time intervals, in selected seismic and volcanic districts, in order to ascertain precursory and other changes in underground stress accompanying great seismic and volcanic disturbances.

5. *Collection and Publication of Statistics of Earthquakes and Eruptions*

There is needed for certain Pacific countries more complete statistics concerning earthquakes and eruptions; and a complete list for the world should be eventually maintained; therefore this conference

Recommends that each Pacific country publish statistical lists of local eruptions, earthquakes, tidal waves and other related phenom-

ena; and issue catalogues of active, dormant and extinct volcanoes, and of local seismic features.

6. *Central Scientific Bureau*

Dissemination of volcanologic and seismologic knowledge will be furthered by working through a body cooperating with all Pacific countries; therefore the conference

Recommends the establishment of a central bureau for dissemination of scientific knowledge among the volcano and earthquake stations of the Pacific.

7. *Geophysical Samoan Station*

This conference commends highly the work done at the Geophysical Observatory at Apia, Samoa; and expresses the hope that the service of that station will be continued.

8. *Education of Dwellers in Districts Liable to Disaster*

Great injury and loss of life to persons and damage to human constructions may be caused by earthquakes and volcanic eruptions and may be decreased by general education; therefore this conference

Recommends that countries liable to seismic disaster educate the people in proper methods of construction, in behavior during emergencies, and in the history of such catastrophes elsewhere.

SAMUEL SHELDON

DR. SAMUEL SHELDON, of the Polytechnic Institute of Brooklyn, died at Middlebury, Vt., of Bright's disease on September 4, 1920. He was a professor of physics and electrical engineering at that institution for the last thirty-one years, and enjoyed a wide reputation as a physicist, educator and consulting engineer. In appreciation of his services to the Polytechnic, his colleagues of the faculty and the members of the corporation at recent meetings adopted the following minute:

The corporation and the faculty of the Polytechnic Institute of Brooklyn desire to give expression to the great loss sustained by the death of Dr. Samuel Sheldon who for thirty-one years served the Polytechnic as professor of physics and electrical engineering.

As an educator he was beloved and admired for his sterling qualities of mind and heart, for his earnestness and enthusiasm in the lecture-room, and for his genial good humor on all occasions. The personal interest he held for his students followed them in their professional work, and he derived pleasure from their achievements. They in turn affectionately called themselves "His Boys."

As an engineer he attained eminence through his integrity and straightforwardness of character; and by forceful personality and keen judgment he reached the highest offices in national engineering societies. This broad contact with the engineering fraternity and his association with men of attainment brought him experience and vision of inestimable value to the Polytechnic.

As a colleague he will always be remembered as a man of action, of precision, yet sympathetic and kind—above all inspiring. He lived for the Polytechnic, worked unceasingly for its upbuilding, and was rewarded with the happiness that came through the realization of his ideals.

We, the members of the corporation and faculty of the Polytechnic Institute, herewith express to his family our deep respect and esteem for our beloved Dr. Sheldon and the profound regret that we shall henceforth be deprived of his valuable assistance and counsel in the solution of our educational problems.

Dr. Sheldon was born in Middlebury on March 8, 1862, the son of Harmon Alexander and Mary Bass Sheldon. He was graduated from Middlebury College in 1883 with the degree of A.B. and then pursued graduate work, receiving the degree of A.M. in 1886. During the next two years he studied at Würzburg, Germany, and received the degree of doctor of philosophy there in 1888. During a part of this time he was associated with Kohlrausch, the distinguished physicist, in his celebrated determination of the ohm as the unit of electrical resistance. He was awarded the honorary degree of doctor of science from the University of Pennsylvania in 1906, and from Middlebury College in 1911.

Dr. Sheldon was the author and joint author of several college text-books. Among them were "Direct-Current Machines," "Alternating-Current Machinery," "Electric Trac-

tion and Transmission Engineering" and "Physical Laboratory Experiments." He had also written a number of monographs and papers on special topics.

Dr. Sheldon was an honorary fellow of the American Electrotherapeutic Association, fellow and past-president of the American Institute of Electrical Engineers, member of the American Physical Society, member and past-president of the New York Electrical Society, member of the American Electrochemical Society, fellow of the American Association for the Advancement of Science, member of the Society for the Promotion of Engineering Education, member, past-vice-president and assistant treasurer of the United Engineering Society and chairman of its library committee, member of the Brooklyn Institute of Arts and Sciences and president of its department of electricity, and member of the Engineers' Club.

Erich Hausmann

SCIENTIFIC EVENTS

THE CALIFORNIA INSTITUTE OF TECHNOLOGY

The California Institute of Technology, Pasadena, California, opened the work of the new year on September 27. The name of this institution was changed from Throop College of Technology to its present name by order of court, on petition of the board of trustees, on April 7, 1920. From the fall enrollment, the total attendance for the year is estimated at 400 students, a substantial increase over the enrollment of last year, which marked the largest attendance up to that time.

The institute has just received from Dr. Norman Bridge an additional gift of $100,000, for the Norman Bridge Physical Laboratory. His original gift for this purpose was $150,000, this addition making a total of $250,000. The construction of the building will be commenced immediately, and the building will be completed for the opening of the college year 1921–1922.

The resignation of Dr. James A. B. Scherer as president of the institute was accepted by the board of trustees on September 11. Dr. Scherer was president of the institute for twelve years. His resignation was occasioned by the condition of his health. When Dr. Scherer assumed the presidency the institute occupied old buildings, its work was almost wholly that of a preparatory school, its endowment very small, and its staff little known in the educational world. To-day it is a scientific institution of recognized standing, it occupies a physical plant consisting of a beautiful campus of twenty-two acres and four modern, reinforced concrete buildings, beautiful in architecture and equipment with the most modern scientific equipment. It has a substantial and constantly growing endowment, and has drawn into its staff men of the highest standing in science and engineering, including such outstanding figures as Dr. Arthur A. Noyes, who has recently become a full-time member of the faculty, Dr. Robert A. Millikan, who, under a cooperative arrangement with the University of Chicago, spends a portion of each year at the institute, and Dr. A. A. Michelson, who as research associate of the institute has recently installed on its campus apparatus for the measurement of earth tides, and has recently spent several months at the institute in connection with this investigation.

Pending the appointment of a new president a faculty administrative committee has been appointed, composed of Franklin Thomas, professor of civil engineering, chairman, Dr. Arthur A. Noyes, director of chemical research, Clinton K. Judy, professor of English and chairman of the faculty, Harry C. Van Buskirk, professor of mathematics and recorder, and Edward C. Barrett secretary of the institute.

New appointments to the staff of the institution are:

John R. Macarthur, B.A., University of Manitoba, 1892; Ph.D., University of Chicago, 1903; associate professor of English.

Captain Frederic W. Hinrichs, U. S. A. Retd., West Point, 1902; B.A., Columbia University, 1902; assistant professor of mechanics.

Captain Hans Kramer, U. S. A. Engineers, West

Point, 1918; professor of military science and tactics.

Samuel A. Tenison, H.S., James Millikan University, 1914; assistant professor of physical education.

Roscoe G. Dickinson, S.B., Massachusetts Institute of Technology, 1915; Ph.D., California Institute of Technology, 1920; National Research Council Fellow; research associate in chemistry.

Clyde L. E. Wolfe, B.S., Occidental College, 1906; M.S., Occidental College, 1907; A.M., Harvard University, 1908; Ph.D., University of California, 1919; instructor in mathematics.

Ernest H. Swift, B.S., in chemistry, University of Virginia, 1918; M.S., California Institute of Technology, 1920; instructor in analytical chemistry.

Fred L. Poole, B.S., California Institute of Technology, 1918; M.S., Union College, 1919; instructor in electrical engineering.

Fred K. Converse, B.S., in mechanical engineering, University of Rochester, 1914; instructor in civil engineering.

Glen G. H. Bowlus, B.S., Purdue University, 1912; instructor in mechanical drawing.

James B. Friauf, A.B., University of Montana, 1918; instructor in physics.

THE HECKSCHER FOUNDATION FOR THE PROMOTION OF RESEARCH AT CORNELL UNIVERSITY

THE committee on general administration of the Cornell University board of trustees, on October 2, adopted a plan for the administration of the income from the Heckscher Foundation for the Promotion of Research in Cornell. August Heckscher gave Cornell University $500,000 last summer as an endowment to promote research. The plan of administration is described in the following resolutions which the committee adopted:

That the income shall be used only for the promotion of research, including the publication of the results thereof.

That for the present the income shall not be used for permanent research professorships.

That the income shall not be used to increase the emoluments of any member of the teaching staff.

That the income shall not be used intentionally to promote investigation leading to patent rights or to the pecuniary benefit of the investigators through patent rights, or in any similar manner.

That for the administration of the foundation there be established a council to be known as the Heckscher Research Council. This council shall consist of the president of the university, *ex officio*, as chairman; two trustees to be elected by the board of trustees whose respective terms as members of the council shall continue until the expiration of their then respective terms as trustees; the dean of the graduate school, *ex officio;* four members of the university faculty, two from each of the two groups known as the group of sciences and the group of letters as specified in Section 2 of Article XII. of the university statutes and relating to the university library; and two emeritus professors to be selected annually by the council.

The terms of the four faculty members to be elected by the groups of the faculty shall, at the first election, be for one, two, three and four years, respectively, and thereafter the term of each shall be four years.

All members of the council shall continue to hold office until their successors are elected.

This council shall, subject to the approval of the board of trustees, have general supervision of research under the Heckscher Foundation, the expenditure of the income of the fund, and all other matters pertaining thereto. The council shall report its recommendations from time to time to the board of trustees and upon the approval of the same the expenditure of appropriations shall follow the usual practise of the university.

The council shall call annually for requests for grants from individual investigators, or groups of investigators proposing to collaborate, but not from departments of the university as such, nor from colleges.

The council shall have power to establish and from time to time modify the rules and regulations governing its meetings and the details of appropriations.

The annual report of progress shall be made to the council by each investigator or group receiving a grant. An annual report to the board of trustees shall be made by the council and a copy thereof sent to the founder of the fund. A minimum of one hundred copies of all publications of the results of the investigations shall be delivered to the council for preservation in the university library and distribution under the direction of the council. A bound copy of such publications shall from time to time be transmitted to the founder.

AUSTRIAN METEOROLOGISTS APPEAL FOR AID

SEVERAL pathetic appeals from Austrian meteorologists or their families have been

received recently by a number of American meteorologists. The following one came to the editor of the *Monthly Weather Review* on October 6:

ZENTRALANSTALT
FÜR
METEOROLOGIE UND GEODYNAMIK.
Wien XIX Hohe Warte 38.

20 September, 1920.

In view of our calamities in Austria, I beg you to help my colleagues, the members of the staff of the Zentralanstalt für Meteorologie in Vienna, in their great need of food. The American Relief Administration Warehouse has published the following circular..

For several weeks the American Relief Administration Warehouses in Austria have been delivering food parcels to holders of food drafts. You can buy at any bank in the United States American Relief Warehouse Drafts and send them to us in Vienna. On presentation of these food drafts at the warehouse in Vienna, we can also draw American food. We are in great need of food in Austria. Individual food parcels sent from America usually do not reach us. Money does us no good when there is no food to buy. Help us in our distress by sending an American Relief Warehouse Food Draft—quickly! For further information apply to American Relief Administration, 115 [present address, 42] Broadway, New York City, or to your own or the nearest bank.

Allow me to draw your attention to it. We are, the families included, 67 persons. We all would thank you very heartily for your kindness.

I am, dear Sir yours very respectfully,

DR. MORIZ TOPOLANSKY, *Secretary*

Contributions whether to a general fund or for any specific class or individual may be sent direct to the American Relief Administration 42 Broadway, New York City. If any further information as to the general situation among the intellectual classes in central and eastern Europe is desired, it may be had from Dr. Vernon Kellogg, National Research Council, Washington, D. C.

A fund for the purchase of food drafts for Austrian meteorologists in the name of the American Meteorological Society has been started by some members of the society. Contributions toward this fund may be sent to Charles F. Brooks, Secretary, Weather Bureau, Washington, D. C.

THE GILMAN MEMORIAL LECTURES ON GEOGRAPHY

THE Johns Hopkins University announces the inauguration of a course of lectures to be known as The Gilman Memorial Lectures on Geography. These lectures are made possible through the generosity of the family of Daniel Coit Gilman, first president of the Johns Hopkins University. Dr. Gilman began his teaching career at Yale (1863–72) as professor of physical and political geography and was a member of the U. S. Commission on the boundary line between Venezuela and British Guiana in 1896–97.

The first series of lectures will begin October 18, and will continue weekly, throughout the academic year. They will be given by Major Lawrence Martin, of the General Staff Corps, who as the chief of the Geographic Section, Military Intelligence Division, U. S. Army, attached to the American Commission to Negotiate Peace, had unusual opportunities for studying at first hand the geographical factors affecting trade in the reorganized states of Europe, Asia Minor and the Caucasus.

SCIENTIFIC NOTES AND NEWS

AT the sixth International Congress of Mathematicians, held at Strasbourg at the end of September, addresses were given by Sir Joseph Larmor, Professor L. E. Dickson, M. de la Vallée-Poussin, M. Volterra and M. Nörlund.

THE Botanical Society of Washington has elected the following officers for the ensuing year: *President,* Charles E. Chambliss; *Vice-president,* P. L. Ricker; *Recording Secretary,* Roy G. Pierce; *Corresponding Secretary,* R. Kent Beattie; *Treasurer,* L. L. Harter.

THE Italian government has conferred upon Dr. Leonard Hill, F.R.S., the Italian silver medal "Ai Benemeriti della Salute Publica."

THE Council for Scientific and Industrial Research of Canada has awarded $5,000 to as-

sist Professor J. C. McLennan, of Toronto University, in investigations on helium to determine the uses for lamps, amplifying values, high resistances, etc.

THE Paris Academy of Sciences has awarded the L. Lacaze prize (10,000 francs) to Dr. Maurice Arthus, professor of physiology at Lausanne.

DR. CHARLES F. CHANDLER, formerly professor of chemistry and dean of the school of mines at Columbia University, received the honorary degree of doctor of science from Union College last June. In conferring the degree, Dr. Charles A. Richmond, chancellor of the university, referred to Professor Chandler in the following language: "Author of many chemical papers; member of many scientific and learned societies both here and abroad. The recipient of distinguished academic honors from universities in America and England. Esteemed by your profession, beloved by generations of grateful students to whom you have imparted both knowledge and wisdom. We delight also to do you honor."

DR. ROBERT M. YERKES, chairman of the Research Information Service of the National Research Council, and Dr. Leonard C. Gunnell, of the Smithsonian Institution, in charge of the Regional Bureau for the United States of the International Catalogue of Scientific Literature, have gone to London to represent these organizations at a conference upon the future of the International Catalogue of Scientific Literature which was held on September 28. Dr. L. E. Dickson, professor of mathematics in the University of Chicago, and Dr. Luther P. Eisenhart, professor of mathematics in Princeton University, who have been in attendance at the organization meeting of the International Mathematical Union at Strasbourg and Dr. S. I. Franz, who has been in Europe this summer, will also attend the conference in London, Dr. Dickson representing the National Academy of Sciences and Dr. Eisenhart and Dr. Franz as additional representatives from the National Research Council.

DR. JOHN J. R. MACLEOD, Toronto, professor of physiology in the University of Toronto, and vice dean of the medical faculty, is chairman of the Committee on Industrial Hygiene in Canada. With him are associated Professor Archibald B. Macallum, members of departments of physiology and psychology in various universities in Canada, and one representative each of the department of labor, Ottawa, of industry, and women's organizations. A secretary of the committee is established in the medical department of the University of Toronto.

PROFESSOR JOHN BRETLAND FARMER, F.R.S., of the Imperial College of Science and Technology, has been appointed a member of the advisory council to the Committee of the British Privy Council for Scientific and Industrial Research.

PROFESSOR VLADIMER KARAPETOFF, of Cornell University, has been nominated for state engineer and surveyor on the socialist ticket.

MR. B. L. JOHNSON, geologist, has been appointed acting chief of the Foreign Section of the Mineral Resources Branch of the U. S. Geological Survey, in the absence of Mr. Eugene Stebinger.

DR. WILLIAM L. TOWER, captain, U. S. A., formerly associate professor of zoology in the University of Chicago, after his return from the army of occupation in Germany and discharge in the summer of 1920, sailed on September 25 for Tampico, Mexico, to assume the directorship of the pathological, bacteriological and x-ray laboratories of the American Hospital, Tampico.

THE resignation of Professor Ernest Blaker, of the department of physics, Cornell University, has been accepted. Professor Blaker has been on leave of absence since the closing of the Aviation School two years ago, when he went to Akron, Ohio, to accept a position with the Goodrich Tire and Rubber Company.

WILLIAM A. BEVAN, formerly assistant professor of physics at the Oregon State Agricultural College, who has been a first lieutenant in the air service since February, 1918, has been appointed a captain in the air service

of the regular army. He is now chief inspector of airplanes and motors in the Aviation Repair and Supply Depot at Rockwell Feld, Coronado, California.

Dr. Henri M. Ami, who has been in Washington at the British Embassy for the last four years, is leaving that post to resume his work at Ottawa, Canada, in connection with the Geological Survey of Canada, Department of Mines. During his stay at the capitol Dr. Ami was asked to take charge of war metals and minerals and derivatives, and is now returning to Canada to devote his time to paleontology and chronological geology in which he was formerly engaged.

Neil M. Judd, curator of American archeology, U. S. National Museum, returned to Washington on October 1 after having spent the preceding five months in Utah, Arizona and New Mexico, engaged in archeological investigations for the Bureau of American Ethnology and the National Geographic Society.

Dr. Jacques Loeb, of the Rockefeller Institute for Medical Research, delivered the first of the Harvey Society Lectures at the New York Academy of Medicine, on Saturday evening, October 6. His subject was "The proteins and colloidal chemistry."

The Cutter lectures on Preventive Medicine and Hygiene will be given on October 19 and 20 in the Harvard Medical School from five to six P.M. by Dr. Theobald Smith, director of the department of animal pathology of the Rockefeller Institute for Medical Research, Princeton, N. J., on "Medical research and the conservation of food-producing animals."

At a special meeting of the Cleveland Academy of Medicine, October 8, Dr. Harvey Cushing, Moseley professor of surgery at Harvard University, surgeon in chief of the Peter Bent Brigham Hospital, Boston, delivered an address on "The Special Field of Neurological Surgery."

The Harveian Oration before the Royal College of Physicians of London will be delivered by Sir Frederick Andrewes, M.D., F.R.S., professor of pathology in the University of London and pathologist to St. Bartholomew's Hospital, on October 18.

The first Murphy Memorial Oration of the American College of Surgeons was delivered by Sir Berkeley Moynihan on October 11 during a meeting of the College in Montreal. The oration has been founded in honor of the late Dr. J. B. Murphy, of Chicago. On the same occasion Sir Berkeley Moynihan presented to the college a mace, the gift of the surgical consultants of the British Army during the war.

By the will of Mrs. Jones an oil portrait of the late Professor George W. Jones, for years a teacher of mathematics at Cornell University, has been bequeathed to the university.

The New York Academy of Medicine has received a cash bequest of $5,000 and a library valued at $4,567 in accordance with the conditions of the will of the late Abraham Jacobi.

Frederick Henry Gerrish, emeritus professor of surgery in the Medical School of the University of Maine, died on September 9, aged seventy-five years. After serving as lecturer and professor of therapeutics, materia medica and physiology at the University of Michigan, Dr. Gerrish returned to his alma mater in 1875 as professor of materia medica and therapeutics. He became professor of anatomy in 1882.

Adolph Gehrmann, emeritus professor of bacteriology and hygiene in the College of Physicians and Surgeons, Chicago, died on October 3, at the age of fifty-two years.

A correspondent writes that Dr. F. Hasenöhel, professor of physics at the University of Vienna, successor to the well-known physicist Boltzmann, was killed in action in the autumn of 1915.

The United States Civil Service Commission announces that the Coast and Geodetic Survey is in need of junior engineers and deck officers and that an examination will be held on December 8 and 9. The entrance sal-

ary offered is $2,000 a year, which will be increased to $2,240 a year after one month of satisfactory service.

THE twenty-fourth Congress of Alienists and Neurologists of French-speaking Countries was held recently at Strasbourg under the presidency of Dr. Dupré, clinical professor of mental diseases at the Paris medical faculty.

WE learn from *Nature* that Mr. J. J. Joicey has acquired for the Hill Museum, Witley, the collection of Lepidoptera formed by Mr. H. J. Elwes, as well as the large collection of Heliconius formed by the late H. Riffarth. The museum has lately also received large collections of Lepidoptera from Central Africa, obtained by Mr. and Mrs. T. A. Barns, who have recently returned from a twelve months' trip undertaken on behalf of Mr. Joicey.

THE U. S. Public Health Service has established at Pensacola a research station for the study of bubonic plague. A number of trained experts in addition to those already on duty in Pensacola will be detailed to that city. Additional research equipment will be provided to facilitate their investigations.

RESEARCH work on the manufacture of oxygen from the engineer's point of view began at the Harvard Engineering School early in the summer under the direction of Dr. Harvey N. Davis, professor of mechanical engineering. The National Research Corporation, founded in 1912 through the efforts of Dr. Frederick G. Cottrell, now director of the U. S. Bureau of Mines, has given Harvard $5,000 for the work. Professor Davis and his associates have undertaken to determine the fundamental data concerning air and its properties, believing that present methods of making oxygen are wasteful, and that the industrial use of oxygen in blast furnaces may result from the elimination of this waste. In return for its backing, Professor Davis has agreed to turn over to the Research Corporation any patents that may develop from his work.

SECRETARY MEREDITH has announced a reorganization of the publication and information work of the Department of Agriculture, and the appointment of a director of information to have general supervision of all these activities, both in Washington and in the field. He has named E. B. Reid, formerly chief of the Division of Publications, to the new position. Mr. Reid's relation to the work will be similar to that formerly held by Assistant Secretary Ousley, who had charge of such activities during the war period. Harlan Smith, formerly in charge of the Office of Information, has been appointed chief of the Division of Publications. The work now being performed by the Office of Information hereafter will be known as the Press Service, which will be in charge of Dixon Merritt, and will continue under the immediate direction of the chief of the Division of Publications. The director of information will bring about closer coordination of the information and publication work of the various bureaus with that of the Division of Publications and will be charged with formulating and executing plans for developing and improving the information service of the department as a whole to the public.

Nature reports the forthcoming establishment in the University of Paris of an Institute of Psychology. The institute will be administered by a council composed of Professors Delacroix, Dumas, Janet, Piéron, and Rabaud, and the deans of the faculty of letters and sciences. It will afford instruction, both theoretical and practical, in general, physiological, experimental, pathological and comparative psychology. To it will be attached the recently established Institute of Pedagogy, forming its pedagogical section. Other sections of the institute, dealing with the general applications of psychology and with vocational selection, will be formed shortly. The institute will grant diplomas to successful students in each of these sections and to those who, after attending other courses of instruction, have passed the examinations therein. It will also be open for research work in connection with the university doctorate or higher diplomas. Previously Professor Janet with his colleague, Professor Dumas, worked in psychopathology quite in-

dependently of the late Alfred Binet, who directed the psychological laboratory. Professor Piéron, Binet's successor, is now joining forces with the representatives of French pathological psychology, and the institute thus formed is also to encourage the applications of psychology to education and to industry.

UNIVERSITY AND EDUCATIONAL NEWS

The will of the late Jacob Schiff includes the following bequests:

To the Montefiore Home and Hospital for Chronic Diseases	$300,000
To the Jewish Theological Seminary of America	150,000
To the Hebrew Union College at Cincinnati	100,000
To the New York University for its School of Commerce and Accounting	50,000
To the Metropolitan Museum of Art	25,000
To the New York Public Library	25,000
To the Zoological Society of the City of New York	25,000
To Harvard University	25,000
To Tuskegee Normal and Industrial Institute	10,000
To Hampton Normal and Agricultural Institute	10,000

At the Medical School of the Johns Hopkins University at least two years of college work, of which one and one third years should be devoted to inorganic and two thirds of a year to organic chemistry, will hereafter be required. Each year's course comprises three class room exercises a week and five to six hours of laboratory work. This represents only a minimal training, and three years' work is advised, including one third of a year devoted to lectures and demonstrations in elementary physical chemistry. After 1923 three years' preparation in chemistry will be required, including at least 240 hours of class room work and 500 hours of laboratory work. The former must include 60 hours in organic chemistry and a short course in physical chemistry; while the latter must include one year's work in quantitative analysis and 120 hours in organic chemistry.

Owing to the death of Alfred J. Moses, professor of mineralogy at Columbia University, the department of mineralogy has been combined with that of geology into a single department of geology and mineralogy. Dr. Lea I. Luquer, now assistant professor of mineralogy has been promoted to be associate professor.

Professor William J. Crozier, of the department of zoology of the University of Chicago, has been appointed professor of zoology and public health at Rutgers College.

Dr. Homer H. Collins, head of the department of biology of the Fresno Junior College at Fresno, California, has become assistant professor of zoology in the University of Pittsburg.

Mr. John Paul Givler, after two years service in the Sanitary Corps, has accepted the headship of the department of biology at the North Carolina College for Women, Greensboro, N. C.

Conrad Thoraldsen and Isaac Neuwirth have been appointed instructors in the departments of histology and of physiological chemistry, respectively, of the New York Homœopathic Medical College and Fowler Hospital.

Albert Salathe, graduate student in the University of Chicago, has gone to Albany, New York, to be professor of chemistry at the Albany College of Pharmacy.

Professor E. H. Kraus, head of the mineralogical department of the University of Michigan, has been made acting dean of the college of pharmacy until a new dean is appointed. Dr. Kraus has for many years been dean of the University of Michigan Summer Session. Mr. Charles G. Stocking has been appointed assistant professor of pharmacy to fill the vacancy caused by the resignation of Professor A. F. Schlichting, who has taken up his work as chief of the Control Laboratories of the William B. Warner Company of Saint Louis.

In the department of geology, University of Kansas, Dr. Raymond C. Moore, professor of geology and paleontology and state geologist, has been made chairman; Professor Chesley J. Posey, of the University of Minnesota, has

been appointed associate professor of geography; Professor Russell S. Knappen, of the University of Chicago, has been appointed assistant professor of economic geology, and Dr. Walter H. Schoewe, of the Colorado School of Mines, has been appointed assistant professor of geology. Dr. Winthrop P. Haynes, associate professor of geology, is absent on leave and will undertake for the Standard Oil Company of New Jersey explorations in northern Mexico.

AT the Carnegie Institute of Technology new appointments have been made as follows: In the division of science and engineering are C. R. Clutter, Lauren C. Hand and Frank E. Rupert, instructors in chemical engineering; R. W. Boreman, W. H. Michner and A. Press, instructors in physics; Charles A. Blodgett and Fred J. Evans, instructors in civil engineering; W. S. McKee, instructor in machine design; David C. Saylor, instructor in mechanical engineering; W. A. Copeland, instructor in metallurgical and mining engineering, W. Z. Price, assistant professor in mining engineering, and C. G. Simpson, instructor in the mechanics department. In the division of industries are Charles B. Walker and F. N. Talley, instructors in chemistry, and James Creech, instructor in press work, in the printing department.

DISCUSSION AND CORRESPONDENCE

AN INSTITUTION FOR TROPICAL RESEARCH

TO THE EDITOR OF SCIENCE: The immense importance of the tropics and of tropical products to the future of industry is being more and more widely recognized. The most rapid developments of the future will inevitably lie to the southward since only there can now be found unlimited, unused opportunity. The greatest volume of trade must ultimately flow north and south rather than east and west since east and west have in the main similar products while those of north and south are complementary. The necessity for a much more accurate and extensive knowledge of tropical conditions, products and resources is being realized by many.

Concrete plans for an American institution devoted to tropical research seem first to have been suggested in the Philippines, where such tremendous strides have been taken along these lines since the American occupation of these islands. Director Arthur F. Fischer, of the Philippine Bureau of Forestry, and Dean C. F. Baker, of the College of Agriculture, have been particularly active in this propaganda. When the Roosevelt Memorial Association was formed it occurred to the present writer that the foundation of such an institution would be a most fitting memorial to the memory of that strenuous advocate of the conservation of natural resources and explorer of tropical wildernesses. An outline for the organization of a Roosevelt Memorial Institution for the Study of Tropical America was accordingly drawn up and was submitted to the association but no favorable action was secured.

At the close of the war the National Research Council was organized from what had been the Council for National Defense. It is understood that the importance of tropical problems has been given due consideration by this body, and that committees have been appointed who have submitted reports but that so far no final action has been taken toward formulating a concrete plan for tropical work. The writer has no connection with the Council for National Research but his interest in everything relating to tropical problems is so great that he begs permission to submit the following for the consideration of this body:

OUTLINE FOR THE ORGANIZATION OF THE ROOSEVELT INSTITUTION FOR TROPICAL RESEARCH UNDER THE AUSPICES OF THE NATIONAL RESEARCH COUNCIL

1. This institution should be organized as a special section of the council with a permanent secretary and an office force to collate and index existing knowledge of tropical resources and conditions. A bibliographic card index should be made indicating in what libraries[1] given works can be consulted.

1 The necessity for such information as this was forcibly brought home to the writer during a recent visit to the libraries of Washington and New

2. All workers should be registered who are able and willing to undertake tropical investigations. Men occupying regular positions can usually secure leave of absence to undertake special investigations in their respective lines. This register should include not only scientific workers in the United States but those from all parts of America and for that matter those from any other part of the world who would care to interest themselves in American problems.

3. Once such a list of available workers has been secured then let it be widely known to the different governments of the Pan-American Union that the institution is in a position to furnish the best attainable expert service, and to supervise all such governmental scientific projects as geological surveys, including special studies of mineral resources; forestry surveys, including suggestions for the utilization of existing forest products and the reforesting of denuded areas; physiographic surveys; archeological studies; faunal or floral studies; special industrial problems; or the investigation of plant diseases, injurious insects or other special agricultural problems.

At the present time when really competent investigators are hard to obtain, the temporary services of the highest class of experts, vouched for and supervised by such an institution, should be very attractive to the governments concerned. The exact form of agreement with the institution and with individual workers could be determined independently in each case. The investigators might receive temporary appointments as officials of the interested governments and their reports be published as official documents by such governments, or any other arrangement could be made that would be mutually satisfactory.

4. In like manner it should be made known to the different industries dependent on tropical products that the resources and personnel of the institution were at their service for the study of any of their special problems. Many of these industries now maintain their own extensive research departments, but the ability to call in the highest possible class of additional expert advisers would doubtless be appreciated, especially in cases of unusual emergency.[2]

As a case in point the United Fruit Co. has for years been suffering heavy losses from the ravages of the banana wilt disease on some of their extensive Central American estates. Their early attempts at hiring expert advisers proved unfortunate, no workable remedies having been suggested by the pathologists employed. As a consequence banana planting has been abandoned on large areas and expensive railroad and other equipment is lying idle. It seems to be a case that is not soluble by ordinary pathological methods. If a council of experts had been available bringing a broader viewpoint to bear on the problem it is likely that some practical solution could long since have been arrived at with great financial advantage to the company. Long range advice without personal investigation is always risky, but in this case the most obvious method for combating banana wilt would seem to be to plant these lands in sugar cane for a term of years. This crop is adapted to banana lands and it would fully utilize the railroad and other equipment. After the wilt fungus had died out of the soil (requiring an unknown number of years) a portion or all of the lands could be again planted to bananas, if that seemed desirable while other lands less well adapted to bananas could be planted to cane to keep up a supply for the mills.

5. Universities, museums and other institutions planning the sending of scientific expeditions to the tropics should be invited to cooperate with this institution in order to ob-

York in a search for the older sugar cane literature. The scanty representation of the literature from South American scientific institutions and experiment stations was quite surprising and there seemed to be a lamentable lack of effort to keep up with current publications from these sources.

[2] Attention is called to the report on Sugar Cane Mosaic or Yellow Stripe Disease recently published in *The Journal of the Department of Agriculture* of Porto Rico, Vol. 3, No. 4, as an example of the cooperative study of a serious tropical agricultural problem.

tain the greatest possible advantages from the expenditures and efforts made.

6. Each special problem would be organized independently, the permanent secretary assigning such workers to it as at the moment were most available. All expenses, including salaries of workers, would be met by the interested parties in each case, either industries or governments. The only expense to the National Research Council would thus be the maintenance of the permanent secretary and his office force engaged in the fundamentally important work of tabulating and correlating existing knowledge of tropical conditions and resources; and of keeping in close touch with all of the many scattered institutions and workers either official or otherwise who are now engaged in any of the lines embraced in this vast field of effort.

As time went on and funds were available the institution could also take up on its own account such lines of investigation as were not being covered by any other initiative.

An organization such as is thus briefly outlined would certainly give the maximum of elasticity and breadth of view with a minimum of fixed charges. It is respectfully submitted for the consideration of the National Research Council.

F. S. EARLE

RIO PIEDRAS, PORTO RICO,
August 23

MILLS AND FISHWAYS

TO THE EDITOR OF SCIENCE: Apropos of the article by Professor Henry B. Ward entitled "Atlantic and Pacific Salmon" in SCIENCE for September 17, 1920, allow me to record some observations. Some years ago I stocked a stream running through my country place in Connecticut with rainbow trout. These trout later ran down to the estuary and could not return because of two mill dams in the way. Discussing the matter with old inhabitants I learned that in former years before the dams were built farmers living along the stream for a distance of fifteen miles or more were in the habit of catching many barrels of alewives and salting them down for winter food supply. These families are now deprived of one important kind of food.

Following up this concrete object lesson I made observations along the Atlantic coast from Connecticut to Labrador. My conclusions are as follows:

Along the New England coast mills are commonly the property of local stockholders and these represent the influential men in a locality. Their first interest is in the mill and its economical management. This excludes the idea of the expense of a fishway. Fish which formerly supplied large numbers of people in the vicinity and at a distance and which naturally would supply the people for all time are prevented from ascending streams for breeding purposes. When the matter is taken up for action by a large number of indignant people they find themselves in conflict with a few influential men personally interested in the dam. This minority has the largest degree of influence with legislators. Along the entire New England coast such appears to be the situation in relation to salmon, shad, and alewives.

Upon reaching the Maritime Provinces of Canada I found a somewhat different situation. The traditions of an older civilization in regard to maintaining large food supply prevail to some extent. They come into conflict with the mill owner and his stockholders to such a degree that some of the streams remain open to anadromous fish, with the aid given by fishways.

Leaving the Maritime Provinces on the way northward I found a third order of conditions prevailing. The men who own cod traps and large nets are the men most influential with legislators. Constituting a small but potent minority they are enabled to injure food supply for the public by their manner of using cod traps and large nets. On some of the runways to salmon rivers the cod traps appear to pick up a large part of the annual run of salmon and the net fisherman at the mouths of the river deplete the fish supply by unlawful obstruction to the run of breeding fish.

My comments do not relate to hearsay but

to personal observation and inquiry extending from Connecticut to as far north as Hamilton Inlet in Labrador. The biology of the subject relates not so much to the habits of *Salmo salar* as it does to the behavior of *Homo sapiens*—with his specific appellation self-chosen.

Robert T. Morris

616 Madison Avenue, New York

EFFICIENCY IN THERMAL PHENOMENA

To the Editor of Science: Mr. Forbes's theory of something being wrong with the commonly accepted definitions of efficiency in thermal phenomena, is provocative of comment. The question of a definition being wrong depends, obviously, on how it is interpreted.

In general the efficiency of a machine or mechanical process, is defined as the ratio of output to input. It is assumed that the output will always be less than the input, hence the efficiency will be less than unity.

It is safe to say that the difficulties alluded to by Mr. Forbes can be traced to failure to distinguish between the quantities of energy called input and output, and the units in which they are measured. In the electric heater, the input, watts, is wholly converted into heat, with efficiency of 100 per cent. In the electric motor the input, watts, is converted into 95 per cent. work and five per cent. heat, giving 95 per cent. efficiency if work output is considered, and 100 per cent. efficiency for the entire output. In the steam engine the input, heat, is converted into ten per cent. work and 90 per cent. heat, giving an efficiency of ten per cent. based on work output, 90 per cent. efficiency based on the exhaust steam for heating, and 100 per cent. for the entire output. In the refrigerating machine the output is, logically, heat carried away by the condenser water. The input, on the same reasoning, is made up of two parts, the heat removed from the brine and the work of driving the machine. The sum of the two input quantities is equal to the output, giving 100 per cent. efficiency as in all the other cases.

The refrigerating engineer recognizes the difficulty of applying the term efficiency to his machine, and substitutes for it the term "coefficient of performance," the ratio of heat absorbed to the work required to drive the machine, both expressed in the same units.

If efficiency is defined by the input-output formula, it is true that the efficiency of all machines is 100 per cent. If only a portion of the input or output is considered, it is possible to have efficiencies of less or more than 100 per cent. In this case it would be appropriate to use the term "partial efficiency," since the entire output is not considered.

E. H. Lockwood

THE HELIUM ARC AS A GENERATOR OF HIGH FREQUENCY OSCILLATIONS

Helium as a conducting medium in a low-voltage arc may be of considerable utility as a convenient source for generating, from direct current, oscillations of moderately high frequency.

Due to its exceptionally low sparking potential arcs may be readily started from a hot tungsten cathode by 110 volts even when the gas is at atmospheric pressure. In fact it is easy to start the arc across a centimeter gap between cold electrodes by means of breaking a parallel circuit with a series reactance common to both. Perhaps a more convenient method of starting, however, is the heating of the filament by the source of supply and then a commutation of the connection to the positive terminal from the filament to the anode.

When the proper inductance and capacity are connected across the arc high frequency oscillations are produced which may be utilized in the usual way with a coupled circuit. Hitherto, hydrogen and compounds of hydrogen have been used in areas to produce high frequency and it is very difficult to produce oscillations by the use of other gases at atmospheric pressure. Helium, however, probably due to its high heat conductivity, being inferior only to hydrogen in this respect, from the rapid rate of energy dissipation in the arc, gives the type of volt ampere

characteristic which is necessary for the production of the alternating current.

From a 6-ampere arc in helium at approximately atmospheric pressure and with a centimeter gap, 50 watts or more of alternating current at 1,000 cycles may readily be obtained.

G. M. J. MACKAY

RESEARCH LABORATORY,
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SCHENECTADY, N. Y.

SCIENTIFIC BOOKS

Collected Studies on the Pathology of War Gas Poisoning, from the Department of Bacteriology and Pathology, Medical Science Section, Chemical Warfare Service, under the direction of M. C. WINTERNITZ, major, M. C., U. S. A. Yale University Press, New Haven, Conn. Cloth, 165 pages, 41 color plates, 83 black and white illustrations, $20.00.

The study of the pathological lesions produced by the war gases upon animals under controlled experimental conditions was of eminent practical importance during the war, and quite justly enlisted the interest and services of many of the foremost pathologists, both here and abroad. Without such control, it would have been difficult and, in many cases, impossible, to draw conclusions as to the comparative effectiveness of different types of gas used in offense; and to estimate the protection afforded by various defensive measures. Equally important was the desirability of defining, so far as this was possible, the effects of the various gases used by the enemy against our troops, and to afford criteria to the pathologists in the field by which they might be recognized.

The studies of Winternitz and his coworkers, which were available to the Chemical Warfare Service during the war, have now been made generally accessible in a comprehensive and beautifully illustrated monograph from the Yale University Press. On the basis of a very large experimental material, the gross and microscopic changes following exposure to chlorine, phosgene, chlorpicrin, trichloromethyl-chloroformate (diphosgene, superpalite), dichloroethylsulphide (mustard gas), cyanogen chloride and bromide, arsine, and several organic arsine-halogen compounds are minutely described. Unlike most of the reports which have previously appeared, the study includes a consideration of late residual lesions as well as the acuter changes, and this phase of the work will prove of particular interest to those who still are seeking an anatomical explanation for the chronic invalidism which afflicts so many of the soldiers gassed in the war. The writers find quite regularly in the lungs after recovery from phosgene, persistent emphysema and atelectasis, associated with obliterating bronchiolitis, and with tubercle-like peribronchial nodules. On the other hand, it is stated that "chronic changes in the lungs after mustard gas inhalation were infrequent and were confined to minute areas of organization occurring in isolated bronchioles or in the alveolar tissue near the margin of the lungs. In no case was any large bronchus found organized or occluded." In a few dogs, localized ulceration or cicatricial stenosis was found in the trachea. This rarity of permanent lesions after gassing with mustard in dogs does not accord with our own experience in the human cases. Without entering into details, it may be confidently stated that the inhalation of mustard gas in man is frequently followed by chronic changes in the entire respiratory tract. These differ, of course, in their extent and severity, but in many cases there results a destruction and deformity comparable to that of chronic pulmonary tuberculosis.

In this connection, it is perhaps proper to emphasize the limitations of these and similar experimental studies on the war gases, in their application to human pathology. Whereas the experimental worker with animals was informed as to the kind of gas used, its concentration and the duration of exposure, none of these data were available to the pathologist in the field. Frequently, it happened that the same soldier was exposed to several varieties of gas within a short period; frequently, also, there were complicating traumatic injuries. Most disturbing of all were the supervening

bacterial infections, and particularly the epidemic influenzal pneumonia which swept through our troops during the period when gas casualties were most numerous. Because of these complexities, many of the human cases presented a difficult problem for the pathologist, and it was not very easy for him to apply fully the knowledge gained from animal experimentation. For example, although blue cross shells containing diphenylchlorarsine were used in profusion against our troops in the later months of the war, and although animal experiments had shown this and related arsine compounds to possess a high degree of toxicity, not a single casualty amongst 576 recorded autopsies could be referred to organic arsine-halogen compounds alone, nor was it possible to differentiate the lesions from those of other vesicant and irritant gases in common use.

Such considerations should not detract from the value of the work. These studies, and the equally painstaking and complete experimental work of Warthin and Weller on Mustard Gas, are fundamental contributions to the pathology of the toxic gases used in the war.

Appended to the purely descriptive studies of gas lesions of various types, is an interesting chapter given to the subject of intratracheal therapy. It was found that dogs will tolerate intrapulmonary irrigation with physiological salt solution in amounts up to three liters, or more, when the fluid is introduced over a period of thirty minutes. Resorption from the lungs takes place very rapidly as could be shown by the elimination of phenolsulphonthalein in the urine; and no serious functional or anatomical disturbances are produced. This raises the question as to how far the œdema itself is responsible for the fatal outcome in cases of acute poisoning with the suffocant gases, and suggests that other factors, such as the increased viscosity of the blood, the obstruction to the pulmonary circulation, and the resultant cardiac weakness, may be of greater moment than the mere accumulation of fluid in the air spaces.

The demonstration that inert granular material and even bacteria can in great measure be washed out of the lungs, opens new possibilities of experimental research along therapeutic lines.

Alwin M. Pappenheimer
Columbia University

SPECIAL ARTICLES

THE TAKE-ALL DISEASE OF WHEAT IN NEW YORK STATE

For nearly two decades plant pathologists have been interested in the possible introduction of the take-all disease of wheat into America. A detailed historical and bibliographic treatment of this and some related diseases of wheat has recently been published by Stevens.[1] Conditions, believed to be due to take-all, have been reported from Oregon in 1902 and more recently (1919) from Illinois and from Virginia. However, the fungus *Ophiobolus graminis* Sacc. has not yet been reported from these localities in the papers which have come to the writers' notice. If the name of "take-all" be restricted to the disease with which *Ophiobolus graminis* is associated, there remains some doubt as to the reported occurrence of the true take-all in this country.

Early in July, 1920, the attention of Mr. R. G. Palmer, field assistant of the Department of Plant Pathology, was attracted to a small spot in a field of soft red winter wheat at East Rochester, New York. The plants within an area eight to ten feet in diameter were badly dwarfed and prematurely dead. In many cases secondary culms had been killed soon after their formation. On July 15 the diseased spot was brought to the attention of Dr. M. F. Barrus who brought specimens into the laboratory for examination. The roots of the plants were rotted and usually broken near the base of the culm when the plants were uprooted. The lower internodes were dark or entirely blackened and enveloped by a dense sheath-like plate of thick-walled brown mycelium. This plate of mycelium was formed between the leaf sheath and culm, as

1 "Foot-rot Disease of Wheat—Historical and Bibliographic," Natural History Survey, Ill. Dept. Registration and Education, Vol. 13, Art. 9, 1919.

described by McAlpine[2] for *Ophiobolus graminis*. Perithicia in considerable abundance were found embedded in the leaf sheath and mycelial plate. Microscopic measurements of perithecia and ascospores agree very closely with those given by Saccardo for *Ophiobolus graminis*.

As soon as a determination of the fungus had been made steps were taken to determine the source of the infection and to completely eradicate the disease from the infected area. An inspection was made of the farm which had grown the seed for the past two years. No evidence of take-all was found on this farm or on any of a considerable number of others in the vicinity of the diseased field and elsewhere. The crop from an area forty feet in diameter was spread over the ground and gasoline was poured over the infected spot and vicinity. The whole was then burned over.

The writers are indebted to Dr. W. B. Brierly, of the Rothamsted Experiment Station, England, and Professor Et. Foëx, of the Station de Pathologie Végétale, Paris, France, for examination of the affected wheat. Dr. Brierly states that the disease is indistinguishable from the take-all as it occurs in England. Professor Foëx concludes that the associated fungus is undoubtedly a species of *Ophiobolus*. Saccardo lists two species of *Ophiobolus* as occurring on wheat, *O. graminis* Sacc. and *O. herpotrichus* (Fr) Sacc. The ascospores of *O. herpotrichus* measure 135–150 × 2–2.5 microns, practically double the spore length of *O. graminis*. It has already been pointed out that the fungus under consideration agrees closely in spore measurements with Saccardo's *O. graminis*. It is not intended here to settle the question of the pathogenicity of the *Ophiobolus* as it occurs in this country or abroad. However, both the fungus and the diseased symptoms with which it is associated agree in essential details with the take-all of wheat and *Ophiobolus graminis* as described in Australia, France and elsewhere.

R. S. KIRBY,
H. E. THOMAS

CORNELL UNIVERSITY

[2] McAlpine, D., "Take-all and White Heads in Wheat," Victoria Dept. Agr. Bul, 9, 1904.

THE AMERICAN CHEMICAL SOCIETY. XII

DIVISION OF PHARMACEUTICAL CHEMISTRY

Charles E. Caspari, *chairman*

Edgar B. Carter, *secretary*

Stability and chloramine antiseptics: JULES BEBIE.

Chemistry and pharmacology of the chloramines: CARL NIELSEN.

Colorimetric estimation of adrenalin: WILBUR L. SCOVILLE.

Improved methods for arsenic estimation: H. F. FARR.

The melting point and the determination of free salicylic acid in acetyl salicylic acid: L. A. WATT.

Biological methods for digitalis assay: HERBERT C. HAMILTON.

Researches on hypnotics: E. H. VOLWILER.

Researches on anesthetics: ROGER ADAMS.

Wood alcohol and prohibition: CHAS. BASKERVILLE.

Drug absorption in the intestinal tract: G. H. A. CLOWES and A. L. WALTERS.

Iodine telerance of the human body and iodine therapy: H. C. P. WEBER. A very unusual case of cure of tubercular meningitis is discussed. Only isolated instances of recovery from this disease are known in the literature. The cure was effected by dosage with extraordinary quantities of iodine, given as tincture with various albuminoses and fatty vehicles of administration. The maximum was 1 gram of iodine per day (equivalent to 0.033 g. per kg. body weight); the total equaled 12.35 g. over 22 consecutive days. No iodism was noted. The conclusions drawn were that (*a*) the maximum dose of I is not known, (*b*) the disturbing effects, iodism, are astonishingly small, or even absent, (*c*) therapeutic effects as bactericide, require piling up of I in the body, (*d*) that the disturbing effects of KI are often confused with the effects of I itself, (*e*) that aside from this, the methods of administering the I are of less significance. These conclusions seem to be worthy of, and require, verification.

The pharmaceutical chemistry and pharmacology of the chloramines: CARL NIELSEN. To obtain best results with the chloramines some knowledge of the chemistry of these products, particularly as regards incompatibilities, combinations and pharmacologic action, is essential.

Research on hypnotics: E. H. VOLWILER. History of hypnotics, soporifices, and sedatives.

Present day hypnotics, with comparative value and uses. Qualities desired in hypnotics and present research in this field.

Research on anesthetics: Roger Adams. Former anesthetics and their uses and drawbacks. Transition from natural to improved synthetic products. Qualifications of a good anesthetic and how the problem is being solved.

Improvements in the methods for arsenic estimation: H. V. Farr. A very brief review of the methods in present use is given. In addition to this a variation in the Gutzeit method is outlined, whereby the preliminary preparation of the chemical in ordinary cases is eliminated. Sulphites, etc., are oxidized by bromine and the arsenic subsequently reduced by potassium iodide, both of these reactions being accomplished within the reaction cell while the test is going on, representing a very great saving of time. In addition to this some simple methods for removing metals which interfere with the Gutzeit test are outlined, thus rendering this method more widely applicable. A gravimetric method for determining arsenic in the metallic form where this metal is present in considerable amounts is outlined. This is particularly applicable in cases where the simpler volumetric methods can not be used.

The colorimetric estimation of adrenalin: Wilbur L. Scoville. Solutions of adrenalin are necessarily acid, if kept in stock, in order to preserve the activity. This acid has a marked effect upon the color produced. The official process is designed for the estimation of adrenalin in the dried glands, and will apply to these, but is not satisfactory for commercial solutions. A method is given which is applicable to both, and which the author considers preferable to the official process. It is based upon Krauss's method, using potassium iodate as the oxidizing agent and pure adrenalin as a standard.

Stability of chloramine antiseptics: Jules Bebie. In order to assure the greatest possible degree of stability the chloramines must be produced with a high degree of purity. Investigation extended over period of one year indicates that chloramine-T in crystal and tablet form, by itself or when mixed with $NaHCO_3$ is stable. Aqueous solutions of chloramine-T alone or in mixture with Na_2CO_3 or NaCl are also stable. Dichloramine-T in powder form begins to deteriorate after about three months. The crystallized commercial product, however, is stable for about 8 months, and after 14 months shows only very slight degree of decomposition. Solutions of crystallized dichloramine-T in chlorosane are fairly stable for a couple of weeks. Halazone is fairly stable. Decomposition after one year amounts to about 3 per cent.

The determination of the melting point and free salicylic acid content of acetylsalicylic acid: L. A. Watt. A comparison of the methods in general use for the determination of the melting point of acetylsalicylic acid. The desirability of a uniform procedure is emphasized by the variation in the results obtained. For estimating the free salicylic acid content, comparison with a set of standards made from a mixed dye solution permits the close approximation of the violet color produced by the addition of ferric chloride to the acteylsalicylic acid solution.

The biologic methods for digitalis assay: Herbert C. Hamilton. The author questions the relevancy of certain criticisms of biologic assay on the ground that such an assay is limited in its scope. Biologic assays are not to decide the question of dosage nor the applicability of the drug for any particular purpose nor does a biologic assay merely record that a drug will kill an animal and permit the inference that the drug is standardized. A biologic assay is a comparison of the sample in question with a similar preparation of known activity. The comparison of effects is made on some test animal which responds to the action of the drug in so characteristic a manner that the effect is measurable. The proposed methods for digitalis with their advantages and disadvantages are described at length in order to emphasize the scope and limitations of the biologic assay of the digitalis series.

Charles L. Parsons,
Secretary

(To be continued)

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